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Requesting AVIRIS Data: A Guide for Principal Investigators

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- FY 1999 AVIRIS Flight Request Form
- Information and Procedures to Access the NASA Airborne Science Program

Introduction

This guide serves as a brief overview of the AVIRIS instrument and its role in the field of imaging spectrometry. Mission planning and flight operations are discussed, and recommendations are given regarding the deployment of ground truth experiments.

Objectives of Imaging Spectrometry with AVIRIS

The AVIRIS sensor collects data that can be used for characterization of the Earth's surface and atmosphere from geometrically coherent spectroradiometric measurements. This data can be applied to studies in the fields of oceanography, environmental science, snow hydrology, geology, volcanology, soil and land management, atmospheric and aerosol studies, agriculture, and limnology. Applications under development include the assessment and monitoring of environmental hazards such as toxic waste, oil spills, and land/air/water pollution. With proper calibration and correction for atmospheric effects, the measurements can be converted to ground reflectance data which can then be used for quantitative characterization of surface features.

Description of Sensor System

- Scanner type: nadir-viewing, whiskbroom
- Image width (swath): 11 km
- Typical image length: 10 - 100 km
- Spatial response: 1.0 mrad, corresponding to a "pixel" 20m x 20m on the ground
- Spectral response: visible to near-infrared (400 to 2500 nm), with 224 contiguous channels, approximately 10 nm wide
- Data quantization: 12 bits
- Data capacity: 10 gigabytes, corresponding to about 850 km of ground track data, per flight

Description of Airborne Platform (ER-2)

- Nominal ground speed: 734 km/hr
- Nominal altitude: 20 km
- Maximum range: 2200 km
- Maximum flight time: 6.5 hours
- Standard deployment sites: Moffett Field, CA; Wallops Island, VA
- Other deployment sites include: Texas, Florida, Kansas, Alaska, Hawaii

Project Management

Operation of the AVIRIS instrument and collection of AVIRIS data aboard the ER-2 is funded primarily through the project office of Mission to Planet Earth at NASA Headquarters in Washington, D.C. This office also reviews experiment proposals and selects the experiments which it will fund. The High Altitude Mission Branch of NASA-Ames Research Center receives flight requests for experiments requiring AVIRIS/ER-2 data collection and, in collaboration with NASA headquarters, drafts aircraft deployment schedules. The AVIRIS project operates under the Observational Systems Division of the Jet Propulsion Laboratory. In addition to operating and maintaining the sensor, the AVIRIS project works to ensure that experiment requirements are met for each flight and that users are satisfied with data quality and the level of service provided.

Data Collection Process

All groups and agencies interested in acquiring AVIRIS data must submit an experiment proposal to NASA headquarters and a flight request to Ames Research Center. These items should be submitted well in advance of the time period for which data collection is desired. Each experiment must designate a Principal Investigator who will serve as a single point of contact for headquarters, Ames, and JPL.

Experiment proposals are reviewed by headquarters, and selections are made based on merit and the program goals of the Mission to Planet Earth office. Once the selection process is completed, the High Altitude Missions Branch at Ames Research Center iteratively designs an aircraft schedule that best accommodates the geographic and seasonal requirements for the suite of approved experiments. An alternative to seeking Headquarters funding for an AVIRIS/ER-2 flight is to contract directly with Ames Research Center on a cost-reimbursable basis. Such arrangements, however, must be approved by NASA headquarters individually.

After the aircraft schedule is drafted, it is distributed to all Principal Investigators. At least one month prior to the beginning of their experiments, investigators will be contacted by the AVIRIS experiment

coordinator to verify experiment requirements and to discuss schedules and arrangements for calibration/validation activities that will accompany data collected during flight operations. The experiment coordinator will also assist investigators in fine-tuning experiment requirements and logistics to ensure the likelihood of a successful mission.

Mission Planning and Execution

AVIRIS experiment requirements are transformed into flight plans by the ER-2 operations team. This team integrates AVIRIS requirements with those of other sensors being used by the ER-2 platform. Whenever possible, multiple experiments are combined into a single mission. The personnel involved in a typical AVIRIS mission include two pilots, A NASA representative, a 7-person aircraft ground crew, and AVIRIS experiment coordinator, and AVIRIS engineer, and engineers for any other instruments aboard the ER-2.

During flight operations, the primary contact for investigators will be the experiment coordinator. The duty of the experiment coordinator is to route all pertinent and time-critical information to/from ER-2 operations from/to the community of AVIRIS investigators. All changes to experiment requirements must be submitted in writing to the experiment coordinator and/or pilot at least 24 hours before they can be implemented. Late submission of requirements changes could result in missed flight opportunities for an experiment.

The following experiment requirements must be provided by the investigator:

- Flight line coordinates, in one of three forms: **1. Start/Stop points**, where latitude and longitude coordinates are given for the starting and ending points of each flight line. **2. Center point,** where latitude and longitude coordinates are given for the center of the line. Flight direction and the length of the flight line must also be specified. **3. Box area**, where latitude and longitude coordinates are given for the four corners of a "box" whose area needs total coverage. The pilots will use this information to draft appropriate flight lines. **Note:** Please specify coordinates using deg-minutes.decimal-minutes format (e.g. 34-48.6 North, 119-29.0 West)
- Weather conditions desired
- Maximum cloud cover, (nominally between 5 and 20%)
- Sun angle limits (may be expressed as a sun angle limit or a "time of day" window. Please specify times in GMT (e.g. 1900 GMT +/- 1 hr.) or with reference to solar noon (e.g. solar noon +/- 2 hrs.) Please do no not use local times.
- Ground conditions, if any
- Other conditions, such as simultaneous satellite overpass, tidal or sea states, etc.

Flights over foreign soil or US military restricted areas must be given approved clearance. It is the responsibility of the investigator to obtain this clearance from the appropriate authorities, and provide the experiment coordinator and/or pilot with the corresponding clearance number at least 24 hours in advance of the flight. This number will be used by the pilot, on approach to the restricted area, to confirm entry into area. Please note that flight lines which are near to or adjacent to restricted areas may also require clearance to be flown.

The day before a flight, a nominal set of target sites is selected. The selection is based on weather predictions, experiment requirements, ground team status, and other operational considerations. The ground teams involved with these experiments are alerted to the possibility if a flight, and the requirements for these experiments are frozen. The launch time is determined from the timing requirements and geographic locations of the experiments considered.

On the day of the flight, three hours before the scheduled launch, a team of key people gathers to make the launch decision. This team consists of the pilot, the ER-2 ground crew chief, the AVIRIS experiment coordinator, the NASA representative, and one or more engineers representing each instrument on the

ER-2: The pilot then makes a launch decision based on immediate considerations of weather, aircraft readiness, instrument readiness, and experiment ground team readiness. The pilot also considers long-term factors such as weather patterns, ground team logistical problems, and schedules of other observation platforms used by the investigators.

Occasionally, a conflict arises whereby two different experiments have good flight conditions, but due to their geographic separation or data requirements, they cannot be flown on the same day. In this situation the priority of the experiment, designated by NASA headquarters or other sponsoring agency, will be taken into account. In the absence of a designated priority, logic will dictate which site gets flown, taking into account the experiments' flight windows, ground team efforts, coordination with other platforms, and rare opportunities for good weather. However, in the vast majority of cases, the factors of weather and experiment timing requirements eliminate all conflict between experiments.

After the launch decision is issued, the affected ground teams are notified, and preparation is begun on the aircraft and instruments. The pilot files his flight plan with Air Traffic Control. If the launch is aborted due to aircraft/instrument anomalies or new weather information, the affected ground teams will be notified. The ground teams will also receive confirmation at the time of launch, if so requested. Coordination of multiple NASA aircraft (DC-8, C-130) is handled by the NASA representative. All other aircraft coordination should be handled by the investigator or designated field contact.

After the flight is completed, the pilot briefs the experiment coordinator on the significant events of the mission, emphasizing any anomalous conditions of the weather, aircraft performance, instrument performance, or any other conditions that would affect data acquisition. The experiment coordinator then fills out an AVIRIS flight log based on information from the flight plan and the post-flight briefing. The data tape and flight log are then shipped by express courier to JPL for processing.

Recommendations for Ground Truth Experiments

The chief purpose of ground truth data collection for AVIRIS experiments is to provide input parameters to radiative transfer or other models that remove the effects of atmospheric absorption and scattering, ultimately converting the radiance data measured by AVIRIS into reflectance data. The ground truth data can also be used to validate the results of AVIRIS data analysis. This section discusses logistics and management issues of ground truth experimental it is not intended as a guide for designing such experiments.

Experiment teams are advised to establish reliable pathways of communications and to test these pathways prior to the start of operations. If the experiment site is in a remote location, it is well worth investing in a portable phone or a radio with phone-patch access. One person or one telephone number should be designated as the central point of contact for the group. A regular call-in schedule for key team members is also recommended, especially during initial deployment and during rotation of field personnel.

A time window of at least two weeks duration is recommended for each experiment to allow for uncertainties in weather patterns and possible equipment failures, air-traffic control problems and other factors. Accepting early data also helps ensure a successful experiment. A compromise in data quality that results from flying at a different time of the month or a different hour of the day is preferable to the possibility of no data at all. An investigator who insists on ideal conditions often ends up, out of desperation, accepting data with 50% cloud cover on the last day of the deployment.

Field team members should recognize that weather appearing to be clear from the ground may still be unacceptable to an airborne sensor, due either to cloud shadow, near-invisible cirrus, or haze. The ER-2 operations team has full access to satellite images and terminal forecast networks and is very experienced at making weather decisions. casual observations of the sky by field teams ("It's really clearing up - you people should fly!") are generally not useful due to the limited horizon of a

ground-based observer. Field teams can, however, assist the weather decision process by providing information on local diurnal weather patterns.

Data Processing and Distribution

All AVIRIS data is processed by the AVIRIS Data Facility at JPL. Two hours after AVIRIS data is received at the data facility, (approximately 20 hours after data collection), a sensor performance evaluation is generated, based on preliminary analysis of the data. This performance evaluation will reveal any anomalies that were not detected by the preflight and postflight diagnostics performed in the field.

With 72 hours after data collection, the data facility will have archived the data and generated quick-look data products. An assessment of data quality (i.e. cloud cover) can also be performed during this period if arrangements have been made through the AVIRIS experiment coordinator. "Quicklook" data will be generated and placed on-line via the AVIRIS Anonymous FTP server. An email message is sent to the Principal Investigator announcing the availability of the data and describing the procedure for downloading it via FTP, or viewing it via a web browser.

After inspecting the quicklooks, the investigator can place an order for the portions of data he/she would like retrieved from e archive. The data can be delivered as raw or calibrated for radiance (this is an instrument-specific calibration, not an atmospheric calibration). In either case, a file is provided that describes the calibration parameters. The investigator has a choice of three mediums: 8-millimeter, 4-millimeter, or 9-track tape. Delivery times vary, based on the current volume of data being processed at the data facility, but generally ranges from 1 - 4 months after data collection.


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AVIRIS Flight Request Forms

If you are running Word 6.0 or higher on your computer, click on the document file name to download the request form. Otherwise, you must use Adobe Acrobat Reader to display and print the form. Return your completed request by mail, fax or e-mail the Word 6.0 document to:

Randy Albertson
MS D1623H
Edwards, CA 93523-0273
Fax: (805) 277-7746
Electronic Mail: Randy Albertson

If you have Word 6.0 or above: **(Word 6.0 Document)**	**For Adobe Acrobat Reader** **Click above to go to Adobe homepage to download free Adobe Acrobat Reader needed to view the following PDF files.**
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Thank You and Have a Great Day.